

AMENDMENTS TO THE CLAIMS

Claims 1-71 (Cancelled)

Claim 72 (New): An image collation apparatus comprising:
an image database for recording a second image as a registered image;
collation means for obtaining a plurality of coincidence ratios by collating a first image with the registered image,

minimum coincidence ratio extraction means for obtaining a minimum coincidence ratio from the plurality of coincidence ratios obtained from said collation means;

maximum coincidence ratio extraction means (30) for obtaining a maximum coincidence ratio from coincidence ratios output from said first collation means (20, 22),

computation means (40) for obtaining a difference between the maximum coincidence ratio output from said maximum coincidence ratio extraction means (30) and the minimum coincidence ratio output from said minimum coincidence ratio extraction means (31), and

determination means (50) for determining that the first and second images are identical, if the difference output from said computation means (40) is not less than a predetermined threshold.

Claim 73 (New): The image collation apparatus according to claim 72, wherein said apparatus further comprises first image transformation means (10, 12, 13) for repeatedly executing at least one of translation processing and rotation processing for the first image within a predetermined range for each collation unit and outputting the first image after the image processing, and said first collation means (20, 22) obtains the coincidence ratio by collating the first image output from said first image transformation means (10, 12, 13) with the second image every time said first image transformation means (10, 12) performs image processing.

Claim 74 (New): The image collation apparatus according to claim 72, further comprising:

computation means (40) for obtaining a quotient by dividing a maximum coincidence ratio output from said maximum coincidence ratio extraction means by the minimum coincidence ratio output from said minimum coincidence ratio extraction means.

Claim 75 (New): The image collation apparatus according to claim 72, wherein said determination means (51) determines that the first and second images are identical, if the maximum coincidence ratio output from said maximum coincidence ratio extraction means (30) is not less than a first predetermined threshold and the minimum coincidence ratio output from said minimum coincidence ratio extraction means is smaller than a second predetermined threshold (first threshold \geq second threshold).

Claim 76 (New): The image collation apparatus according to claim 73, further comprising:

second image transformation means (11, 14) for repeatedly executing at least one image processing of translation processing and rotation processing for the first image located at a first initial position by a predetermined amount within a predetermined range, and outputting the first image after image processing,

second collation means (21) for obtaining a coincidence ratio by collating the first image output from said second image transformation means (11) with the second image every time said second image transformation means (11) performs image processing, and

storage means (60) for storing a translation amount, rotational angle, or both a translation amount and rotational angle of the first image from the first information position to a current position when the coincidence ratio output from said second collation means becomes maximum, and

said first image transformation means (12) moves the first image to a second initial position set by adding the translation, rotational angle, or translation amount and rotational angle stored in said storage means (60) to the first initial position, and executes at least one of translation processing and rotation processing for the first image.

Claim 77 (New): The image collation apparatus according to claim 76, wherein the range predetermined for said first image transformation means (12) is narrower than the range predetermined for said second image transformation means (11).

Claim 78 (New): The image collation apparatus according to claim 76, wherein a collation region in which said second collation means (21) obtains the coincidence ratio is smaller than a collation region in which said first collation means (22) obtains the coincidence ratio.

Claim 79 (New): The image collation apparatus according to claim 76, wherein the translation amount, rotational angle, or translation amount and rotational angle by which said second image transformation means (12) moves the first image for each moving operation are larger than the translation amount, rotational angle, or translation amount and rotational angle by which said first image transformation means moves the first image for each moving operation.

Claim 80 (New): The image collation apparatus according to claim 73, further comprising:

reference point detection means (70) for detecting reference points of the first and second images located at the first initial position, and

correction amount computation means (80) for obtaining a translation amount, rotational angle, or both translation amount and rotational angle of the first image which is required to make the reference points of the first and second image coincide with each other, and

said first image transformation means (13) moves the first image to a second initial position set by adding the translation amount, rotational angle, or translation amount and rotational angle obtained by said correction amount computation means (80) to the first initial position, and executes at least one of translation processing and rotation processing for the first image.

Claim 81 (New): The image collation apparatus according to claim 76, further comprising:

reference point detection means (70) for detecting reference points of the first and second images located at the first initial position, and

correction amount computation means (80) for obtaining a translation amount, rotational angle, or both translation amount and rotational angle of the first image which is required to make the reference points of the first and second image coincide with each other, and

said second image transformation means (14) moves the first image to a new first initial position set by adding the translation amount, rotational angle, or translation amount and rotational angle obtained by said correction amount computation means (80) to the first initial position, and executes at least one of translation processing and rotation processing for the first image.

Claim 82 (New): The image collation apparatus according to claim 72, wherein

said apparatus further comprises region designation means (65) for sequentially designating a plurality of collation regions predetermined as regions in which the first and second images are collated with each other, and

said first collation means (20) obtains coincidence ratios by sequentially collating the first and second images with each other in the collation regions designated by said region designation means (65).

Claim 83 (New): The image collation apparatus according to claim 82, further comprising:

computation means (40) for averaging minimum coincidence ratios corresponding to the respective collation regions output from said minimum coincidence ratio extraction means (31), and for averaging maximum coincidence ratios corresponding to the respective collation regions output from said maximum coincidence ratio extraction means (30).

Claim 84 (New): The image collation apparatus according to claim 73, further comprising:

region designation means (65) for sequentially designating a plurality of collation regions predetermined as regions in which the first and second images are collated with each other, and

said first collation means (20) sequentially obtains a coincidence ratio by collating the first image output from said image transformation means with the second image in each collation region designated by said region designation means (65) every time said first image transformation means performs image processing.

Claim 85 (New): The image collation apparatus according to claim 84, further comprising:

computation means (40) for averaging minimum coincidence ratios corresponding to the respective collation regions output from said minimum coincidence ratio extraction means (31), and for averaging maximum coincidence ratios corresponding to the

respective collation regions output from said maximum coincidence ratio extraction means (30).

Claim 86 (New): The image collation apparatus according to claim 84, further comprising:

selection means for comparing minimum coincidence ratios corresponding to the respective collation regions which are output from said minimum coincidence ratio extraction means (31) and sequentially outputting only a predetermined number of minimum coincidence ratios in increasing order, and for comparing maximum coincidence ratios corresponding to the respective collation regions which are output from said maximum coincidence ratio extraction means (30) and sequentially outputting only a predetermined number of maximum coincidence ratios in decreasing order, and

said computation means (40) averages the minimum coincidence ratios output from said selection means, and averages the maximum coincidence ratios output from said selection means.

Claim 87 (New): The image collation apparatus according to claim 72, further comprising:

image processing means (600, 601) to reduce a width of an edge portion of a ridge of the second image and to output the second image with a reduced ridge width,

said transformation means receives the first image and shifts each pixel of the first image by a predetermined amount and outputs the first image, and

said collation means collates the test image output from said image processing means with the output from the said collation means.

Claim 88 (New): The image collation apparatus according to claim 87, wherein said image processing means (600, 601) to perform selection of one of contraction and expansion for one of the first and second images.

Claim 89 (New): The image collation apparatus according to claim 88, wherein said image processing means (600, 601) performs reduction of the width of the edge portion of the ridge of the second image by repeatedly executing image processing for a selected image for a predetermined amount.

Claim 90 (New): The image collation apparatus according to claim 72, wherein said image processing means further comprises:
thinning means (610) for decreasing a line width of an input image to a value corresponding to about one pixel, and
expansion means (620) for fattening the image output from said thinning means, and
increases the line width corresponding to about one pixel to a predetermined width, and outputs the image.

Claim 91 (New): The image collation apparatus according to claim 87, further comprising:
storage means (701) for storing an image output from said image processing means and outputting the image to said collation means.

Claim 92 (New): The image collation apparatus according to claim 73, further comprising:
second image transformation means (14) for repeatedly executing at least one of translation processing (shifting) and rotation processing for the first image located at the first initial position within a predetermined range for every predetermined amount, and outputting a first image after the processing,
second collation means (24) for obtaining a coincidence ratio by comparing/collating the first image output from said second transformation means with the second image every time said second image transformation means performs processing, and
storage means (61) for storing a translation amount, rotational angle, or translation amount and rotational angle of the first image from the first initial position

to a current position when the coincidence ratio output from said second collation means becomes maximum, and

said first image transformation means (13) moves the first image to a second initial position set by adding the translation amount, rotational angle, or translation amount and rotational angle stored in said storage means (61) to the first initial position, and executes at least one of translation processing and rotation processing for the resultant first image.

Claim 93 (New): The image collation apparatus according to claim 92, further comprising:

image processing means (601) for selecting one of contraction and expansion for the second image and performing a plurality of different image processes, and

said storage means (701) for storing the second image output from said image processing means, and

said second collation means (24) obtains a coincidence ratio by comparing/collating the first image output from said second image transformation means with the second image output from said storage means every time said second image transformation means performs processing.

Claim 94 (New): The image collation apparatus according to claim 92, wherein the range predetermined for said first image transformation means is narrower than the range predetermined for said second image transformation means.

Claim 95 (New): The image collation apparatus according to claim 92, wherein the translation amount, rotational angle, or translation amount and rotational angle by which said second image transformation means moves the first image for each moving operation are larger than the translation amount, rotational angle, or translation amount and rotational angle by which said first image transformation means moves the first image for each moving operation.

Claim 96 (New): The image collation apparatus according to claim 92, wherein a collation region in which the coincidence ratio is obtained by said second collation means is smaller than a collation region in which a coincidence ratio is obtained by said first collation means.

Claim 97 (New): An image collation apparatus comprising:
first collation means (20, 22) for obtaining a relationship between first and second images for each collation unit by collating the first and second images with each other;
minimum coincidence ratio extraction means (31) for obtaining a minimum coincidence ratio from coincidence ratios in the relationship obtained from said first collation means;
region designation means (65) for sequentially designating a plurality of collation regions predetermined as regions in which the first and second images are collated with each other,
maximum coincidence ratio extraction means (30) for obtaining a maximum coincidence ratio from coincidence ratios output from said first collation means (20, 22),
computation means (40) for obtaining a difference between the maximum coincidence ratio output from said maximum coincidence ratio extraction means (30) and the minimum coincidence ratio output from said minimum coincidence ratio extraction means (31), and
determination means (50) for determining that the first and second images are identical, if the difference output from said computation means (40) is not less than a predetermined threshold, and said first collation means obtains coincidence ratios by sequentially collating the first and second images within the collation regions designated by said region designation means (65).

Claim 98 (New): The image collation apparatus according to claim 97, further comprising:

image processing means (600, 601) to reduce a width of an edge portion of a ridge of the second image and to output the second image with a reduced ridge width,

transformation means to receive the first image and to shift each pixel of the first image by a predetermined amount and to output the first image,

wherein said first collation means collates the second image output from said image processing means with the output from the said collation means for selecting one of contraction and expansion for one of the first and second images having, said second image undergoing no image processing.

Claim 99 (New): An image collation method comprising:

recording a second image as a registered image;

collating a first image with the registered image to obtain a plurality of coincidence ratios ;

extracting a minimum coincidence ratio from the plurality of coincidence ratios obtained from collating;

determining that the first image and a registered image are identical if the extracted minimum coincidence ratio is smaller than a predetermined threshold value,

extracting a maximum coincidence ratio from coincidence ratios output in the collating,

determining a difference between the maximum coincidence ratio and the minimum coincidence ratio, and

determining that the first and second images are identical if the difference between the maximum coincidence ratio and the minimum coincidence ratio is not less than the predetermined threshold.

Claim 100 (New): The image collation method according to claim 99, further comprising:

obtaining a quotient by dividing the maximum coincidence ratio by the minimum coincidence ratio, and

determining that the first and second images are identical if the quotient is not less than another predetermined threshold.

Claim 101 (New): The image collation method according to claim 99, further comprising:

determining that the first and second images are identical if the maximum coincidence ratio is not less than a first predetermined threshold and the minimum coincidence ratio is smaller than a second predetermined threshold (first threshold \geq second threshold).

Claim 102 (New): The image collation method according to claim 99, further comprising:

repeatedly executing at least one image translation process and rotation process for the first image located at a first initial position by a predetermined amount within a predetermined range,

collating the first image after image processing the second image every time image processing is performed for the first image to obtain a coincidence ratio, and

storing a translation amount, a rotational angle, or both a translation amount and the rotational angle of the first image from the first information position to a current position when the coincidence ratio becomes maximum, and

moving the first image to a second initial position set by adding the translation, the rotational angle, or translation amount and the rotational angle stored in the storing to the first initial position, and at least one of translation process and rotation process is executed for the first image.

Claim 103 (New): The image collation method according to claim 102, wherein the predetermined range in the at least one image translation is narrower than a predetermined range in another image translation.

Claim 104 (New): The image collation method according to claim 102, wherein a collation region in which the coincidence ratio is obtained in collating the second image is smaller than a collation region in which the coincidence ratio is obtained in collating the first image.

Claim 105 (New): The image collation method according to claim 102, wherein the translation amount, the rotational angle, or the translation amount and the rotational angle by which the first image is moved in the translation of the second image for each moving operation are larger than the translation amount, the rotational angle, or the translation amount and the rotational angle by which the first image is moved in the translation of the first image for each moving operation.

Claim 106 (New): The image collation method according to claim 102, further comprising:

- detecting reference points of the first and second images located at the first initial position,

- determining a correction amount including obtaining a translation amount, a rotational angle, or both the translation amount and the rotational angle of the first image which is required to make the reference points of the first and second image coincide with each other, and

- the at least one transformation process for the first image comprises:

- moving the first image to a second initial position set by adding the translation amount, the rotational angle, or the translation amount and the rotational angle obtained in the determining the correction amount to the first initial position, and executing the at least one of translation process and rotation process for the first image.

Claim 107 (New): The image collation method according to claim 106, further comprising:

- detecting reference points of the first and second images located at the first initial position before executing at least one other translation process and rotation process, and

the determining the correction amount is required to make the reference points of the first and second image coincide with each other, and

the at least one other translation process and rotation process comprises:

moving the first image to a new first initial position set by adding the translation amount, the rotational angle, or the translation amount and the rotational angle obtained in the determining the correction amount to the first initial position, and executing the at least one of translation process and rotation process for the first image.

Claim 108 (New): The image collation method according to claim 103, further comprising:

sequentially designating a plurality of collation regions predetermined as regions in which the first and second images are collated with each other, and

sequentially collating the first and second images with each other in the collation regions to obtain coincidence ratios.

Claim 109 (New): The image collation method according to claim 108, further comprising:

image processing including selecting one of contraction and expansion for one of the first and second images and performing a plurality of different image processes, and

collating the first and second images with each other, said collating including collating an image having undergone the image processing with another image having undergone no image processing.

Claim 110 (New): An image collation method comprising:

a first collating to obtain a relationship between a first image and a second image by collating the first image and the second image with each other;

extracting a minimum coincidence ratio by obtaining the minimum coincidence ratio from coincidence ratios in the relationship obtained in the first collating;

determining that the first and second images are identical if the extracted coincidence ratio is smaller than a predetermined threshold; and

sequentially designating a plurality of collation regions predetermined as regions in which the first and second images are collated with each other,

obtaining a maximum coincidence ratio from coincidence ratios output in the first collating, and

obtaining a difference between the maximum coincidence ratio and the minimum coincidence ratio,

wherein coincidence ratios are obtained by sequentially collating the first and second images within the collation regions.

Claim 111 (New): The method according to claim 110, further comprising:
selecting one of contraction and expansion for one of the first and second images,
and

collating the first and second images, wherein said collating includes collating an image having undergone image processing with another image having undergone no image processing.

Claim 112 (New): A recording medium storing image collation program instructions for causing a computer to execute:

recording a second image as a registered image;

collating a first image with the registered image to obtain a plurality of coincidence ratios;

extracting a minimum coincidence ratio from the plurality of coincidence ratios obtained from collating; and

determining that the first image and a registered image are identical if the extracted minimum coincidence ratio is smaller than a predetermined threshold value

extraction a maximum coincidence ratio from coincidence ratios from the plurality of coincidence ratios,

determining a difference between the maximum coincidence ratio and the minimum coincidence ratio, wherein the first and second images are identical if the difference between the maximum coincidence ratio and the minimum coincidence ratio is not less than the predetermined threshold.

Claim 113 (New): The recording medium according to claim 112, further comprising:

performing first image transformation by repeatedly executing at least one of a translation process and a rotation process for the first image within a predetermined range for each collation unit,

wherein said collating obtain a coincidence ratio by collating the obtained first image after image processing with the second image.

Claim 114 (New): The recording medium according to claim 112, further comprising:

determining a quotient by dividing the maximum coincidence ratio by the minimum coincidence ratio,

wherein the first and second images are identical if the quotient is not less than a predetermined threshold.

Claim 115 (New): The recording medium according to claim 112, further comprising:

determining that the first and second images are identical if the maximum coincidence ratio is not less than a first predetermined threshold and the minimum coincidence ratio is smaller than a second predetermined threshold (first threshold \geq second threshold).